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Frontiers in Geoscience Colloquium

Monday, June 13, 2016

3:00pm – 4:00pm

Physics Auditorium (TA-3, Bldg 215)

Biocementation as an Advanced Well Remediation Technology – Technology Development from the Microscale to the Field-Scale

Prof. Robin Gerlach

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We recently completed a second field-scale demonstration of the biomineralization sealing technology validating that microbially-induced calcium carbonate precipitation (MICP) cannot only be used to seal fractures in sandstone surrounding wells but also restore well integrity in compromised wellbore cement.

This presentation will focus on the successful field demonstrations completed in a well at the Gorgas Powerplant in Alabama (USA) but will also provide an overview of the experimental and modeling efforts completed prior to, during and after the demonstrations.

The first field demonstration (in April 2014) succeeded in sealing a sandstone fracture at around 1116 ft below ground surface (bgs). The results indicated that the biofilm-induced mineralization technology reduced injectivity, increased the re-fracturing pressure, and reduced the ability to inject fluids after re-fracturing.

The second field demonstration (in April 2016) targeted a region of compromised well cement at around 1017 ft bgs. After biomineralization treatment, injectivity was significantly reduced. Flow rate had to be decreased by almost two orders of magnitude as pressure increased to remain below a pressure (1200 psi) that could potentially initiate a fracture in the shale formation surrounding the well at that depth. A significant increase in the solids content in the compromised cement region after sealing was observed (from comparing Ultrasound Imaging Tool [USIT] logs). Lastly, pressure fall-off tests after MICP treatment met a definition of a mechanical integrity test for shut in wells which is “less than 10% pressure fall off in 15 minutes.

These successes were achieved by employing readily available oil-field technology, including a slickline-operated bailer delivery system, a 27/8” tubing string and fluid injection using a pulsed injection strategy

The rationale and success of the laboratory and modeling work leading up to the field demonstrations will be summarized in the context of the field demonstrations. This work consisted of micro- to meso-scale reactors, packed sand columns and core samples of up to 70 cm diameter operated at ambient and elevated pressures (>75 bar). Darcy-, pore network-, and pore-scale reactive transport models have been developed and guided the experimental and field-demonstration efforts.

We have now developed biofilm and mineral precipitation strategies that can be engineered to manipulate porous and fractured media. We are in the process of engineering biofilm-induced mineral precipitation for the development of beneficial processes including bioremediation, enhanced oil recovery, abatement of saltwater intrusion, soil stabilization, and maintenance of well integrity.

Host: Mark Porter, EES-14, 6-1971



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